

CLAIMS

We claim:

1. In a transform-based audio encoder, a method of dynamically selecting between joint channel coding and independent channel coding of a multi-channel input audio signal, the method comprising:
 - for a portion of the multi-channel input audio signal, measuring disparity between excitation patterns of individual channels of the multi-channel input audio signal;
 - determining whether to encode the portion using joint channel coding or independent channel coding based at least in part on the measured disparity; and
 - encoding the portion using the determined joint channel coding or independent channel coding.
- 15 2. The method of claim 1 further comprising:
 - for the portion of the multi-channel input audio signal, measuring energy separation between coding channels for joint channel coding and those for independent channel coding; and
 - determining to encode the portion using joint channel coding or independent channel coding based also at least in part on the measured energy separation between said coding channels for joint channel coding and for independent channel coding.
- 25 3. The method of claim 1 wherein measuring the disparity between excitation patterns of individual channels comprises determining a ratio of aggregate excitation measures of the individual channels of the multi-channel input audio signal.
- 30 4. The method of claim 1 wherein measuring the disparity between excitation patterns of individual channels comprises determining a ratio of expected noise-to-excitation ratio measures of the individual channels of the multi-channel input audio signal.

5. The method of claim 1 wherein said measuring and determining comprise:

determining a ratio of aggregate excitation measures of the individual channels of the multi-channel input audio signal; and

5 determining not to encode the portion using joint channel coding if the ratio exceeds a threshold.

6. The method of claim 1 wherein said measuring and determining comprise:

10 determining a ratio of expected noise-to-excitation ratio measures of the individual channels of the multi-channel input audio signal; and

determining not to encode the portion using joint channel coding if the ratio exceeds a threshold.

15 7. The method of claim 1 further comprising determining not to encode the portion using joint channel coding if a ratio of an excitation pattern-based measure of individual channels of the multi-channel input audio signal exceeds a first threshold, and a smaller of the excitation pattern-based measures does not exceed a second threshold.

20 8. The method of claim 1 wherein said method is performed as an open-loop process.

9. A data-carrying medium having a compressed audio stream produced 25 by the method of claim 1 carried thereon.

10. A transform-based audio encoder, comprising:
a multi-channel transformation component operative to perform a multi-channel transformation on multiple individual channels of a multi-channel audio input signal to 30 produce joint coding channels;
a transform-based encoding component operative to encode multiple coding channels into a compressed data stream;

an excitation pattern disparity measuring component operative to produce a excitation pattern disparity measure of disparity in excitation patterns between channels; and

5 a channel coding mode selecting component operative to select between a joint channel coding mode in which the transform-based encoding component encodes the joint coding channels into the compressed data stream and an independent channel coding mode in which the transform-based encoding component encodes the individual channels of the multi-channel audio input signal, the channel coding selection component basing said selection at least in part upon the excitation pattern disparity

10 measure.

11. The transform-based audio encoder of claim 10 further comprising:
an channel energy separation measuring component operative to produce a channel energy separation measure of energy separation between the joint coding channels and the individual channels; and
the channel coding mode selecting component further basing said selection also at least in part on the channel energy separation measure.

12. The transform-based audio encoder of claim 10 wherein the excitation pattern disparity measuring component operates to produce the excitation pattern disparity measure as a ratio of aggregate excitation measures of the individual channels of the multi-channel input audio signal.

13. The transform-based audio encoder of claim 10 wherein the excitation pattern disparity measuring component operates to produce the excitation pattern disparity measure as a ratio of expected noise-to-excitation ratio measures of the individual channels of the multi-channel input audio signal.

14. The transform-based audio encoder of claim 10 wherein the channel coding mode selecting component determines not to encode a portion of the multi-channel audio input signal with the joint channel coding mode if the excitation pattern disparity measure exceeds a threshold.

15. The transform-based audio encoder of claim 10 wherein the channel coding mode selecting component determines not to encode a portion of the multi-channel audio input signal with the joint channel coding mode if the excitation pattern 5 disparity measure exceeds a minimum disparity threshold, and a smaller excitation pattern of the individual channels exceeds a minimum excitation threshold.

16. In a transform-based audio encoder, a method of improved band truncation, the method comprising:

10 performing a transform on a portion of an input audio signal to produce a set of transform domain coefficients;
selecting as an open-loop process a portion of the transform domain coefficients for band truncation as a function of a target quality measurement;
suppressing the selected portion of the transform domain coefficients from 15 encoding in a compressed audio data stream.

17. The method of claim 16 wherein the target quality measurement is a target noise-to-excitation ratio for the input audio signal.

20 18. The method of claim 16 further comprising:
measuring an achieved quality measurement of the input audio signal encoded with the selected portion of the transform domain coefficients suppressed;
selecting as a closed-loop process a second portion of the transform domain coefficients for second band truncation as a function of the achieved quality 25 measurement; and
suppressing the selected second portion of the transform domain coefficients from encoding in a second compressed audio data stream.

19. A data-carrying medium having a compressed audio stream produced 30 by the method of claim 16 carried thereon.

20. A transform-based audio encoder with improved band truncation, comprising:

an open-loop band truncator operating to select a first selection of transform domain coefficients for band truncation based on a target quality setting for an input

5 audio signal;

a quality analyzer operative to analyze the input audio signal as encoded with band truncation using the first selection to produce an achieved quality measurement;

a closed-loop band truncator operating to select a second selection of transform domain coefficients for band truncation based on the achieved quality measurement;

10 and

a transform encoder operative to encode the input audio signal with band truncation using the second selection.

21. In a transform-based audio encoder, a method of encoding a multi-channel audio input signal, the method comprising:

performing a multi-channel transformation on multiple input channels of the multi-channel audio input signal to produce a plurality of joint coding channels;

selectively suppressing at least one of the joint coding channels as a function of at least quality of reproduction, rate control buffer fullness, and channel separation; and

20 encoding the multi-channel audio input signal with said selective suppression of said at least one joint coding channel.

22. The method of claim 21 wherein the selectively suppressing comprises scaling the at least one joint coding channel by a scaling factor having a value varying 25 based on a current average level of quality, current rate control buffer fullness and amount of channel separation.

23. The method of claim 22 further comprising measuring the current average level of quality as a noise-to-excitation ratio for a portion of the multi-channel 30 audio input signal.

24. The method of claim 21 wherein the selectively suppressing the at least one joint coding channel is also a function of a rate setting of the transform-based audio encoder.

5 25. A data-carrying medium having a compressed audio stream produced by the method of claim 21 carried thereon.

26. A transform-based audio encoder for multi-channel audio signals, comprising:

10 a multi-channel transformer operating to convert multiple individual channels of an input multi-channel audio signal into joint channels via a multi-channel transformation;

a channel suppressor operative to selectively suppress at least one of the joint channels based on at least one suppression parameter, wherein the suppression

15 parameters comprise values of a current quality of audio reproduction, a current rate buffer fullness, and a current channel separation; and

an inverse transformer operating to convert the joint channels via an inverse of the multi-channel transformation to produce a re-matrixed multi-channel audio signal.

20 27. The transform-based audio encoder of claim 26 further comprising:

a quality analyzer operating to calculate a noise-to-excitation ratio value of the audio signal, and to provide the calculated noise-to-excitation ratio value as the value of the current quality of audio reproduction to the channel suppressor.

25 28. In a transform-based audio encoder, a method of improving coding efficiency, the method comprising:

converting a block of samples of an input signal into a plurality of transform domain coefficients;

30 quantizing the transform domain coefficients according to quantization step-size values of quantization bands for the transform domain coefficients;

identifying any quantization bands of transform domain coefficients that are quantized to zero;

modifying the quantization step-size value of said any identified quantization bands to encode in fewer bits in a quantization matrix; and

encoding the quantization step-size values of the quantization bands in the quantization matrix.

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29. The method of claim 28 further comprising:

performing band truncation causing transform domain coefficients of at least some quantization bands to quantize to zero.

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30. The method of claim 28 wherein the modifying comprises, for any identified quantization band:

selecting a modified value that is represented in fewer bits than the respective identified quantization band's original quantization step-size value when encoded in the quantization matrix; and

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modifying the quantization step-size value for the respective identified quantization band to the modified value for encoding in the quantization matrix.

31. The method of claim 28 wherein the encoding comprises differential coding of the quantization step-size values in the quantization matrix.

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32. The method of claim 28 wherein the modifying comprises setting the quantization step-size values of said any identified quantization bands to a same value, whereby differential coding of the modified quantization step-size values in the quantization matrix takes fewer bits.

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33. The method of claim 28 wherein the modifying comprises setting the quantization step-size values of said any identified quantization bands to a quantization step-size value of a non-identified quantization band, whereby differential coding of the modified quantization step-size values in the quantization matrix takes fewer bits.

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34. A data-carrying medium having a compressed audio stream produced by the method of claim 28 carried thereon.

35. A transform-based audio encoder, comprising:
a frequency domain transformer for converting blocks of input audio signal
samples to frequency domain coefficients;
- 5 a quantizer for quantizing the transform domain coefficients according to
quantization step-sizes of quantization bands for the transform domain coefficients;
and
- 10 a quantization matrix encoder for encoding a quantization matrix in a header for
a frame of the input audio signal, the encoding comprising encoding the quantization
step-sizes of the quantization bands in the quantization matrix, the quantization matrix
encoder further operating to identify any quantization bands with zeroed transform
coefficients and to modify the quantization step-size of such identified quantization
bands to encode with fewer bits in the quantization matrix in the header.
- 15 36. A transform-based audio encoder of claim 35 further comprising:
a band truncator for selectively zeroing transform domain coefficients of a
portion of the quantization bands.